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PHYSIOLOGICAL DEMANDS IN FOOTBALL, FUTSAL AND BEACH SOCCER: A BRIEF REVIEW

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Abstract:
Football, futsal and beach soccer are modalities classified as Team Sports. Within this category, these modalities are still classified as invasion games. The objective of this work is to make a brief review of the physiological demands present in each of these modalities by checking similarities and differences between them. In football, approximately 90% of energy consumption comes from aerobic metabolism. The average intensity varies between 80-90% HR_{max}. VO_{2max} varies between 50-75 $ml \cdot kg^{-1} \cdot min^{-1}$, according to the different field positions. In futsal, the average intensity varies between 85-90% HR_{max}. With regard to aerobic capacity, VO_{2max} values between 50-55 $ml \cdot kg^{-1} \cdot min^{-1}$ seem to be ideal. In addition to aerobic capacity, futsal also needs high-capacity anaerobic, the most of the decisive actions of the game takes place in efforts not greater than 5s. The beach soccer, because it is played on beach sand, has increased the intensity of exercise. Thus, the presence of the muscle strength is very important. The average intensity is greater than 90% HR_{max} during most of the match. Anaerobic capacity is also essential; the duration of high intensity efforts is less than 2s. We can conclude that it is common and essential to the 3 modalities a great aerobic capacity. The intensity of a futsal match, and especially of beach soccer, is more pronounced than in a football match. Thus, both futsal and in beach soccer, is also indispensable a high anaerobic capacity and a greater presence of the muscle strength.

Keywords: physiological demands, team sports, football, futsal, beach soccer

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Introduction

Football, futsal and beach soccer are games included in a category named as Team Sports, due to incorporating the six invariants mentioned by Bayer (1986): (i) ball or similar object; (ii) playing space; (iii) opponents, (iv) teammates; (v) a target to attack and a target to defend; and (vi) specific rules. Also are included in this category sports such as basketball, handball, hockey, water polo, rugby, among others.

Within this category, these sports are still classified as invasion games. Team Sports of invasion are characterized by confrontation - attack versus defence - grounded in relations of opposition versus cooperation (Garganta, 2002), invasion of opponent game field (as the occupation of space), direct struggle for ball possession (as the dispute of the ball), ball circulation (as the prevailing trajectories), predominantly, the energy-functional point of view, intermittent efforts, alternating mixed (aerobic-anaerobic) (Garganta, 1998) and acyclic activities (Nunes et al., 2012).

Since these modalities are similar in their technical gesture (Leal Jr. et al, 2006), we intend to analyze the internal dynamics of the football, futsal and beach soccer; allowing increase knowledge and establish similarities and differences between the sports classified in the same category in order to identify and understand possible variables that explain the phenomena occurring. Thus, we can increase and/or detail the knowledge of these modalities, improving the training process and, consequently, the performance in competition, developing their degree of specificity (Castellano & Casamichana, 2010).

Currently, these modalities are highly competitive, with teams that are at very similar levels in relation to the demands and physiological demands that accompany them, several times resorting to science to increasingly achieve positive results (Gomes et al., 2011). Thus, the objective of this work is to make a brief review of the physiological demands present in team sports of invasion, in particular football, futsal and beach soccer, verifying similarities and differences between them.

Physiological Demands

Since these modalities classified inside of same category and subcategory, the football, futsal and beach soccer present common features as the physiological demands and physical requirements, such as, maintaining optimal levels of aerobic endurance. However, due to the particularities of each type (surface where it is practiced, size of the playing area, number of players, playing time, substitutions, etc.), the evolution of the rules, specialization in technical terms, tactical and energetic-functional, these modalities seem to move away from increasingly (Amaral & Garganta, 2005). Thus, will be held a brief description of the main physiological characteristics found in each of these modalities:

Football

The physiological demands in football have been intensively studied (Bangsbo, 1994; Reilly, 1984; Stolen et al., 2005; Bangsbo et al., 2007). Football is a sport with intermittent characteristics, strenuous intensity, emphasizing the force components, speed and endurance (Gorostiaga et al., 2009).

Unlike futsal and beach soccer, football presents larger dimensions and prolonged game time, the greater number of athletes and fewer stops stopwatch, moreover, has a limited number of substitutions. Due to the long period of a football match, much of its energy release, approximately 90% of the total game time, comes from aerobic metabolism (Bangsbo, 1994; Nunes et al., 2012; Stolen et al., 2005). During a match, the athletes run on average of 10-13 km (Bangsbo et al., 1991; Bangsbo et al., 2006; Helgerud et al., 2001; Reilly, 1997; Stolen et al., 2005) at an average intensity of work next to the anaerobic threshold, 80-90% of maximum heart rate (HR_{max}) (Bangsbo, 1994; Bangsbo et al., 2007; Helgerud et al., 2001, Reilly, 1994; Reilly & Ball,1984; Stolen et al., 2005).

For football, the literature indicates reference VO_{2max} values between 50-75 $ml \cdot kg^{-1} \cdot min^{-1}$ according to the different field positions (Bangsbo, 1994; Ekblom, 1986; Stolen et al., 2005). Present high VO_{2max} values in football seems to be more interesting than in futsal and beach soccer, and this importance is mainly in positions that require higher volume game, as players who play in midfield (Di Salvo et al., 2007; Nunes et al., 2012). Football is an activity that involves both aerobic exercises as anaerobic (Osgnach et al., 2009). Thus, the elite football players have high demands aerobic during a match and extensive anaerobic requirements during periods of a match, leading to major metabolic changes (Bangsbo et al., 2007).

Anaerobic activity may constitute the most crucial moments of the match and contribute directly to the win, the ball possession and scoring or conceding goals (Reilly et al., 2000). During a football match, elite players are involved in about 150-250 actions (Bangsbo et al., 2007) of 15-20m high intensity exercise (Bangsbo et al., 2006; Osgnach et al., 2009). A sprint occurs approximately every 90s, each lasting on average 2-4s (Bangsbo et al., 1991; Helgerud et al., 2001b; Reilly et al., 2000; Stolen et al., 2005). Sprints constitute 1-11% of the total distance travelled during a game (Bangsbo et al., 1991; Stolen et al., 2005), corresponding to 0.5-3% of the effective play time (i.e. the time that the ball is in play) (Helgerud et al., 2001b; Stolen et al., 2005). These sprints are almost always less than 30m, half of them being lesser than 10m (Valquer, 1998).

However, these activities comprise often the decisive parts of a football match (Helgerud et al., 2001b).

Futsal

Futsal is a high-intensity intermittent sport (Gorostiaga et al., 2009) which is characterized by a succession of movements in maximum speed in very small spaces (5-10m), with continuous changes of direction and sense, followed by phases muscle tension more statics, but of maximum tension, and chaining low, average and maximum intensity runs, with active and incomplete recovery breaks (Álvarez-Medina et al., 2002).

This modality emphasizes the running speed and stamina, and requires substantial levels of strength for kicks, start-ups, quick changes of direction and capacity repeated of sprints during the actions of the matches (Barbero-Alvarez et al., 2008; Gorostiaga et al., 2009). Such characteristics and demands can be explained by the fact that futsal submit an unlimited number of substitutions, so intensity levels during the game are extremely high, with no decrease in performance during the match (Álvarez-Medina et al., 2002).

Barbero-Alvarez et al. (2008) found average values of HR of 174 beats·min^{-1}, corresponding to 90% of the HR_{max} during 72% of playing time. The author also demonstrated that the total distance travelled (%) in maximum speed during the match of futsal was held above 85% HR_{max} for more than 80% of the time on the court. Moreover, during the short periods of rest, HR was rarely below 150 beats·min^{-1}. According to Alvarez-Medina et al. (2002), futsal requires cardiovascular adaptation between 85-90% of the individual HR_{max}.

With regard to aerobic capacity, VO_{2max} values between 50-55 ml·kg^{-1}·min^{-1} seem to be advisable for professional athletes of this modality (Castagna et al., 2009). The high pace of play that is required in today's competitive futsal is unthinkable without a corresponding suitable aerobic power (Alvarez-Medina et al., 2002), mainly for better energy recovery between repeated sprints (Nunes et al., 2012).

In addition to the aerobic capacity as a discriminate variable of the futsal, this sport, of intermittent feature and high physical demand, needs values indicating high anaerobic capacity, which is a determining factor in modality (Nunes et al., 2012). The most of decisive actions that overbalance the matches to either team, occurs in efforts of a duration no higher of 5s and are performed at higher speed and possible intensity, they are realized thanks to alactic anaerobic pathway (specifically the alactic anaerobic power) (Álvarez-Medina et al., 2012).

Barbero-Alvarez et al. (2008) demonstrated that athletes run approximately 8.9% of the total distance (4-6km) at sprints, revealing the high demands imposed by competition and suggesting that this is a sport with greater physical demands. In fact, the ratio of work and rest is 1:1 (for every minute "rest" there are 1 minute "work").

According to the results found in the study by Nunes et al. (2012), the futsal players (compared to football players) had higher values of HR, HR at the ventilatory threshold (HR_{vt}), VO_{2max}, oxygen consumption at ventilatory threshold (VO_{2vt}), percentage of maximum oxygen consumption ($\%VO_{2max}$), probably resulting from the high load arising from anaerobic metabolism. Thus, athletes showing a better anaerobic conditioning also have an easier removal of lactic acid by the circulatory pathways.

Beach soccer

The Beach Soccer is a team sport that requires its varied physical valences players due to the demands of the sport itself and the soil in which it is practiced (Barbosa, 1998; Pereira et al., 2007; Silva et al., 2005 as cited in Escobar et al., 2011). Considered an intermittent modality, has among its features a very important physical valence: the muscle strength, in that it is played on beach sand, which increases the intensity of exercise (Fazolo et al., 2005).

It is important to mention the disadvantage imposed by the playing surface in beach soccer (Castellano & Casamichana, 2010). The sandy soil dampens the impact during the race, making it difficult displacement and reflecting smaller distance values travelled and speed reached (Escobar et al., 2011). The instability and lower resistance of the sand generate an overload in the ankle joint causing greater effort at the time to push, as it becomes necessary to greater movement of hip flexion and knee (Giatsis et al., 2004 as cited in Escobar et al., 2012).

On firm surface as concrete (futsal) and grass (football), the energy expended for the realization of joint movements seems to be reused in the extensor muscles of the lower limbs, increasing movement efficiency (Muramatsu et al., 2006 as cited in Escobar et al., 2012). In the context of beach soccer as players cannot run as high intensities as in other forms of football (football and futsal), because a playing surface that does not enable such rapid movements as those attainable on other surfaces (Castellano & Casamichana, 2010).

Castellano and Casamichana (2010) measured the HR of Spanish amateur beach soccer players and found that most of the time (59.3%) players are at a frequency >90% HR_{max}. In this sense, the beach soccer is characterized as an intermittent character sport of high intensity, which calls for high energy demand and of the anaerobic system (considered an important source of energy during games), with intensities above 90%

HR_{max}. On average, a beach soccer athlete travels a distance of approximately 100m every minute of the game, being necessary, therefore, high speed and short recovery intervals with labour ratio 1.4:1 (for every minute "rest" there are 1.4 minute "work"), which reflects the nature of a very high intensity sport (Scarfone et al., 2009; Castellano & Casamichana, 2010).

With regard to the mean distances and durations of the different movement categories, the mean distance covered during the highest intensity efforts was 8-10m, while their duration was less than 2s (Castellano & Casamichana, 2010). Both the average HR and time spent percentages in each intensity zone show similar values (although slightly less) than those obtained in indoor soccer studies (Barbero-Alvarez et al., 2008; Castagna et al., 2009; Castellano & Casamichana, 2010).

Conclusion

Despite the classification of these modes within the same category (team sports) and subcategory (invasion games) and gestures having similar engines, due to the characteristics of each mode (gaming surface, playing time, substitutions, specific rules, etc.), football, futsal and beach soccer have different physiological demands.

With respect to these physiological demands, we can conclude that it is common and essential to the 3 modalities a great aerobic capacity. The intensity of a game of futsal, and especially of beach soccer is more pronounced than in a football match. Thus, both futsal and in beach soccer, is also indispensable a high anaerobic capacity and a greater presence of muscle strength, especially in beach soccer.

These specificities generate significant differences between the physiological characteristics of the beach soccer and futsal players, compared with football players. Thus, we can say that these physiological differences also show the need for specific training methods for athletes of each sport.

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